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U.S. PATENT APPLICATION

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Invention: ACCUMULATION TYPE FUEL INJECTION SYSTEM

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SPECIFICATION

ACCUMULATION TYPE FUEL INJECTION SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application is based on and incorporates herein by reference Japanese Patent Application No. 2002-332703 filed on November 15, 2002.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION:

The present invention relates to an accumulation type fuel injection system, in particular to sealing structure of an accumulation device of the accumulation type fuel injection system.

2. DESCRIPTION OF RELATED ART:

As one of accumulation type fuel injection systems, a common rail type fuel injection system for a diesel engine having a high-pressure supply pump and a common rail is known, for instance. The high-pressure supply pump is rotated by a crankshaft of the diesel engine so that the supply pump pressurizes fuel drawn from a fuel tank and discharges the high-pressure fuel. The common rail functions as a kind of surge tank for accumulating the high-pressure fuel discharged from the high-pressure supply pump.

The fuel is accumulated in the common rail at a relatively high pressure (a pressure 100 to 1000 times as high as the atmospheric pressure, or more). The accumulated fuel is supplied to combustion chambers of cylinders by injection

through injectors mounted on the cylinders. A certain common rail as the accumulation device of this kind has structure in which a flow limiter is attached to the common rail as shown in Fig. 4. The flow limiter stops the fuel supply to the injector if the high-pressure fuel is injected from the injector excessively. In the common rail structure, the common rail is formed in a deformed shape so that a thickened screw portion, which is screwed and connected with the flow limiter, and a common rail main body are formed in a single piece. Since the common rail is formed into the deformed shape in a single piece, processing accuracy in perpendicularity between a central axis of the screw portion and a flat surface of a flat sealing portion of the common rail main body can be achieved easily and high-pressure sealing structure can be maintained.

As shown in Fig. 4, the flow limiter has a body formed with a screw portion screwed with the common rail, a valve member capable of moving in an axial direction in the body, and a spring for biasing the valve member toward the flat sealing portion. The flat sealing portion contacts a lower end surface of the valve member to define an initial position of the valve member so that a moving distance of the valve member in the axial direction is set to a predetermined distance. The valve member moves in the axial direction in accordance with an upstream and downstream pressure difference.

However, the common rail having the structure of the conventional technology is the deformed product formed by

forging and the like. Therefore, there is a problem that production cost is relatively high.

A joined common rail can be employed as a countermeasure to the above problem. The joined common rail is made by forming the common rail main body and the thickened screw portion as separate parts and by joining the thickened screw portion to the common rail main body into the single common rail by welding and the like. The thickened screw portion and the common rail main body formed as the separate parts are joined with each other with heat by welding, in which both the thickened screw portion and the common rail main body are melted, or by blazing with blazing filler. Therefore, under some welding conditions or blazing conditions, there is a possibility that a central axis of a threaded portion of the thickened screw portion may not become perpendicular to the flat surface of the flat sealing portion, and the thickened screw portion may be joined in an inclined state. In this case, there is a possibility that the flat sealing portion may contact a sealing portion of the flow limiter unevenly. As a result, high-pressure sealing performance may be degraded.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an accumulation type fuel injection system, which is formed in inexpensive structure and is capable of improving high-pressure sealing performance.

It is another object of the present invention to provide

an accumulation type fuel injection system having an accumulation device, which has an accessory portion corresponding to a safety device and supplies accumulated high-pressure fuel though the accessory portion, so that the accumulation type fuel injection system is formed in inexpensive structure and is capable of improving high-pressure sealing performance.

According to an aspect of the present invention, an accumulation type fuel injection system has a high-pressure supply pump, which is driven by an internal combustion engine to rotate so that the high-pressure supply pump pressurizes and discharges drawn fuel, and an accumulation device for accumulating the high-pressure fuel discharged from the high-pressure supply pump. The accumulation type fuel injection system supplies the accumulated high-pressure fuel to cylinders of the internal combustion engine through injectors mounted to the cylinders. The accumulation device has a common rail main body, distributing portions and accessory portions. The common rail main body is formed with an accumulation chamber for accumulating the high-pressure fuel. The distributing portion can be connected with a pressure introduction pipe for introducing the high-pressure fuel accumulated in the common rail main body to each injector. The accessory portion is disposed on a fuel outlet side of the distributing portion and is connected to the distributing portion and the pressure introduction pipe in thread connection. Each accessory portion has a sealing member

between the accessory portion and a connection object on the distributing portion side, to which the accessory portion is connected in thread connection. A sealing surface of the sealing member on the connection object side is formed in the shape of a substantially spherical surface.

Thus, the accumulation device (the common rail) as a kind of surge tank of the above accumulation type fuel injection system for accumulating high-pressure fuel supplied to the respective cylinders of the internal combustion engine has the common rail main body, the distributing portions and the accessory portions. The distributing portion can be connected with the pressure introduction pipe corresponding to each cylinder. The accessory portion is disposed on an outlet side of the distributing portion and is connected with the distributing portion and the pressure introduction pipe in thread connection. In this case, generally, each accessory portion has to be screwed to a threaded portion formed on an inner peripheral surface of the distributing portion, and an end surface of the accessory portion and an innermost surface on an inner peripheral side of the distributing portion have to be sealed. For instance, sealing performance can be maintained suitably by improving processing accuracy in perpendicularity of a sealing surface with respect to a central axis of the threaded portion. However, production cost of process such as a threading process of the threaded portion through a forging process or a cutting process is increased. Specifically, compared to the processing of an

external surface, the processing accuracy in the perpendicularity between a female thread and the innermost surface is difficult to achieve in the case where the female thread, or an internal surface, is processed.

On the contrary, the sealing member having a sealing surface in the shape of a substantially spherical surface on the connection object side is disposed between the accessory portion and the connection object on the distributing portion side. The accessory portion is connected to the distributing portion in thread connection. Therefore, even if the inclination of a central axis of the threaded portion remains deviated, or even if the accessory portion remains inclined, the sealing member can be connected to the connection object through the spherical surface of the sealing member, while the sealing member is positioned arbitrarily.

Accordingly, even in the case where the inclination of the central axis of the threaded portion is deviated, a fastening force generated by the thread connection can be applied to the connection object stably through the sealing member having the spherical surface. Therefore, variation in processing accuracy is permitted, so inexpensive structure is achieved. Sealing performance can be improved by employing the connection structure for connecting the accessory portion to the connection object in thread connection through the sealing member having the spherical surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of an embodiment will be appreciated, as well as methods of operation and the function of the related parts, from a study of the following detailed description, the appended claims, and the drawings, all of which form a part of this application. In the drawings:

Fig. 1 is a schematic structural diagram showing a common rail type fuel injection system according to the present embodiment of the present invention;

Fig. 2 is a cross-sectional diagram showing a common rail shown in Fig. 1 taken along the line II-II;

Fig. 3 is an enlarged fragmentary diagram showing an area III in Fig. 2; and

Fig. 4 is a cross-sectional view showing a common rail of a conventional common rail type fuel injection system.

DETAILED DESCRIPTION OF THE REFERRED EMBODIMENT

Referring to Fig. 1, a common rail type fuel injection system as an accumulation type fuel injection system of the present embodiment of the present invention is illustrated. The common rail type fuel injection system in Fig. 1 is mounted to a diesel engine.

As shown in Fig. 1, the common rail type fuel injection system has a plurality of (four, in the present embodiment) injectors 2, a high-pressure supply pump 3, a common rail 4, and an electronic control unit (an ECU) 10. The injectors 2 are mounted to respective cylinders of a multi-cylinder

internal combustion engine (a multi-cylinder engine) 1 such as a multi-cylinder diesel engine. The high-pressure supply pump 3 is driven by the multi-cylinder engine 1 to rotate. The common rail 4 functions as the accumulation device for accumulating the high-pressure fuel discharged from the high-pressure supply pump 3. The ECU 10 electronically controls the plurality of injectors 2. The ECU 10 is a control device for controlling the engine 1. The ECU 10 is controlling means for controlling the high-pressure supply pump 3 and the like, in addition to the injectors 2.

The injector 2 is a fuel injection valve mounted to a combustion chamber of each cylinder of the multi-cylinder engine 1 for supplying the high-pressure fuel into the combustion chamber by injection. The ECU 10 electronically controls start and stop of energization to an injection period controlling electromagnetic valve (injection period varying means) 2a as an actuator. Thus, the ECU 10 determines characteristics of the fuel injection into the combustion chamber of the multi-cylinder engine 1 from the injector 2 such as fuel injection quantity or fuel injection timing. The injector 2 mounted to each cylinder of the multi-cylinder engine 1 supplies the high-pressure fuel accumulated in the common rail 4 into the combustion chamber of the cylinder while the injection period controlling electromagnetic valve 2a is open.

The high-pressure supply pump 3 has a known low-pressure feed pump, a plunger and a pressurizing chamber (a plunger

chamber). A pump driving shaft 12 rotates in accordance with the rotation of a crankshaft 11 of the multi-cylinder engine 1, so the low-pressure feed pump draws the fuel from a fuel tank 9. The plunger is driven by the pump driving shaft 12. The pressurizing chamber pressurizes the fuel by reciprocating motion of the plunger. The high-pressure supply pump 3 is a supply pump for pressurizing the fuel drawn by the low-pressure feed pump through a fuel pipe 13 and for discharging the fuel to the common rail 4. An inlet flow control valve (an injection pressure controlling electromagnetic valve) 7 is disposed on an inlet side of a fuel passage leading to the pressurizing chamber of the high-pressure pump 3. The inlet flow control valve 7 functions as an actuator for opening or closing the fuel passage. The inlet flow control valve 7 is a flow control valve as a discharge quantity controlling electromagnetic valve for controlling the discharging quantity of the fuel discharged from the high-pressure supply pump 3 to the common rail 4. The inlet flow control valve 7 is electronically controlled by a control signal from the ECU 10. The inlet flow control valve 7 is controlled by the ECU 10 to regulate pressure-feeding quantity, or discharging quantity, of the high-pressure fuel pressure-fed from the high-pressure supply pump 3 to the common rail 4 through a fuel pipe 16. Thus, the inlet flow control valve 7 functions as injection pressure varying means for varying the injection pressure for injecting the fuel from the respective injectors 2 into the combustion chambers of the multi-cylinder engine 1.

The common rail 4 is a kind of surge tank for accumulating the fuel at a relatively high pressure (a common rail pressure 100 to 1000 times as high as the atmospheric pressure, or more) and is the accumulation device for accumulating the high-pressure fuel at the common rail pressure. The common rail 4 is required to continuously and fluid-tightly accumulate the high common rail pressure corresponding to fuel injection pressure. Therefore, the common rail 4, the fuel passage for introducing the high-pressure fuel from the high-pressure supply pump 3 to the common rail 4 and the fuel passages for introducing the high-pressure fuel from the common rail 4 to the injectors 2 are required to have mechanical strength and high pressure tightness enough to withstand the common rail pressure. Therefore, the fuel pipe 16 for introducing the high-pressure fuel from the high-pressure supply pump 3 to the common rail 4 is provided as a high-pressure fuel passage formed of a pressure introduction pipe (a high-pressure pipe) such as an injection steel pipe capable of fluid-tightly connecting the high-pressure supply pump 3 with the common rail 4. The fuel passages for introducing the high-pressure fuel from the common rail 4 to the injectors 2 are provided by high-pressure pipes 15 formed of high-pressure fuel passages capable of fluid-tightly connecting the common rail 4 with the injectors 2.

A pressure limiter 6 is mounted to the common rail 4 for preventing the common rail pressure in the common rail 4 from

exceeding a limit accumulation pressure. The pressure can be released through the pressure limiter 6. Return fuel from the pressure limiter 6, leak fuel from the injectors 2 and overflow fuel from the high-pressure supply pump 3 is returned to the fuel tank 9 through leak pipes (low-pressure pipes) 14 as low-pressure fuel passages.

The ECU 10 is a known microcomputer including a CPU for performing control processing and calculation processing, ROM for storing various programs and data, RAM for storing input data, an input circuit, an output circuit, a power source circuit, an injector driving circuit and a high-pressure pump driving circuit. Sensor signals outputted from various sensors are inputted to the microcomputer after the sensor signals are converted from analog signals to digital signals by an A/D converter. The ECU 10 includes injection quantity and fuel injection timing determining means, injection pulse width determining means and injector driving means. The injection quantity and fuel injection timing determining means determines optimum injection timing (injection start timing) and the fuel injection quantity (an injection period corresponding to the fuel injection quantity) in accordance with an operating condition of the multi-cylinder engine 1. The injection pulse width determining means calculates an injector injection pulse having an injection pulse period (injection pulse width) corresponding to the operating condition of the multi-cylinder engine 1 and the fuel injection quantity. The injector driving means applies the

injection period controlling electromagnetic valve 2a of the injector 2 of each cylinder with the injector injection pulse through the injector driving circuit (EDU). The ECU 10 also functions as discharge quantity controlling means for calculating the optimum fuel injection pressure, or the optimum common rail pressure, in accordance with the operating condition of the multi-cylinder engine and for performing driving control of the injection pressure controlling electromagnetic valve 7 of the high-pressure supply pump 3 through the high-pressure pump driving circuit (EDU). The ECU 10 calculates the fuel injection quantity, the injection timing and the target common rail pressure by using operating condition detecting means for detecting the signals representing the operating condition of the multi-cylinder engine 1 such as a rotation speed sensor 41 for sensing rotation speed of the multi-cylinder engine 1, an accelerator position sensor 42 for sensing a depressed degree of an accelerator pedal (an accelerator position), and a cooling water temperature sensor 43 for sensing cooling water temperature. The fuel injection quantity, the injection timing and the target common rail pressure may be corrected by considering detection signals (engine operation information) from other sensors 44 as the operating condition detecting means such as an intake temperature sensor, a fuel temperature sensor, an intake pressure sensor, a cylinder determination sensor and an injection timing sensor.

Next, the common rail 4 as the accumulation device as a

substantial part of the accumulation type fuel injection system of the present invention will be explained based on Figs. 1, 2 and 3. As shown in Fig. 1, the common rail 4 has a common rail main body 4a, inside which an accumulation chamber 4c for accumulating the high-pressure fuel is formed, and distributing portions 4b, which can be connected with the high-pressure pipes 15 for introducing the high-pressure fuel accumulated in the common rail main body 4a to the injectors 2 of the respective cylinders.

The common rail main body 4a is formed into a predetermined shape through a forging process, a cutting process for cutting its entire surface, a drawing process or a flatting process. As the predetermined shape of the common rail main body 4a, the common rail main body 4a is formed substantially in the shape of a relatively thick pipe. A cross-section of the accumulation chamber 4c formed inside the common rail main body 4a is formed substantially in the shape of a round or an ellipse. The accumulation chamber 4c extends in a longitudinal direction of the common rail main body 4a (in a lateral direction in Fig. 1). Thus, the common rail 4 has a simple shape, which can be easily formed through the drawing process or the flatting process. Therefore, production cost for processing is reduced.

In the case where the common rail main body 4a is formed by forging, the common rail main body 4a is merely formed substantially into the shape of a pipe. Therefore, compared to the forged product formed into the deformed member having

the conventional structure shown in Fig. 4, structure of a forging die can be simplified and the increase in the processing cost of the forging process can be inhibited.

The distributing portion 4b is formed substantially in the shape of a cylinder as shown in Fig. 2. The distributing portions 4b and the common rail main body 4a are formed as separate parts in advance through separate processes, for instance. Then, the common rail main body 4a and the distributing portions 4b are integrated by welding or brazing. The distributing portions 4b connected with the common rail main body 4a branch substantially perpendicularly to the longitudinal direction of the common rail main body 4a, in which the accumulation chamber 4c extends, as shown in Figs. 1 and 2. Thus, the high-pressure fuel is distributed toward the injectors 2 disposed in the respective cylinders of the multi-cylinder engine 1.

Thus, the common rail main body 4a and the distributing portions 4b are formed as the separate parts and are integrated by the welding and the like. Therefore, unlike the conventional forged product, there is no need to form the common rail 4 in a single piece by shaping a complicated and deformed member. Thus, the production cost can be reduced. The common rail main body 4a, to which the distributing portions 4b are connected, should preferably have cylindrical portions 4a1 formed substantially concentrically with connection objects (innermost surfaces, sealing surfaces) 4s on the sides of the distributing portions 4b respectively, and

stepped surfaces 4a2 formed around the cylindrical portions 4a1 respectively. Thus, an inner periphery of each distributing portion 4b can be connected to the cylindrical portion 4a1. Meanwhile, a connecting area for connecting a lower end surface of the distributing portion 4b with the stepped surface 4a2 by welding can be ensured easily.

Moreover, in the present embodiment, as shown in Figs. 1 and 2, an accessory portion (a flow limiter) 4h corresponding to a safety device is disposed on an outlet side of each distributing portion 4b. The accessory portion 4h is connected with the distributing portion 4b and the high-pressure pipe 15 in thread connection respectively. Moreover, as shown in Fig. 1, the accessory portion 4h and the distributing portion 4b seal a lower end surface 4h2 of the accessory portion 4h and the innermost surface 4s formed radially inside the inner periphery of the distributing portion 4b, at which a threaded portion 4b1 for the thread connection is formed, through a sealing member 4d with a fastening axial force generated by the thread connection.

The accessory portion 4h is screwed with the threaded portion 4b1 formed on an inner peripheral surface of the distributing portion 4b. An end portion (a lower end surface) 4h2 of the accessory portion 4h and the innermost surface 4s radially inside the distributing portion 4b are required to be sealed so that high-pressure sealing performance is maintained. In this case, generally, accuracy of form related to physical relationship between the threaded portion 4b1 of the

distributing portion 4b, which partially or entirely accommodates the accessory portion 4h, and the innermost surface 4s has to be improved. For instance, processing accuracy of the perpendicularity between the flat surface of the flat sealing surface as the connection object and the central axis of the threaded portion has to be improved like the conventional structure shown in Fig. 4. By improving the processing accuracy, the high-pressure sealing performance can be improved. However, the processing cost will be increased. For instance, in the case of the forged common rail, a die accuracy of a die used in the forging pressing has to be improved. As a result, the processing cost is increased.

On the contrary, in the present embodiment, as shown in Figs. 2 and 3, the sealing member 4d having a fuel passage 4d3 is disposed between the accessory portion 4h and the sealing surface 4s as the connection object on the distributing portion 4b side, to which the accessory portion 4h is connected in the thread connection. A sealing surface 4d1 of the sealing member 4d on the connection object 4s side is formed substantially in the shape of a spherical surface. The sealing surface 4s as the connection object is formed in the shape of a conical surface as shown in Figs. 2 and 3. Therefore, the sealing member 4d can be connected to the connection object 4s even if the axis, or a position, of the sealing member 4d is set arbitrarily with respect to the connection object 4s. As a result, the accessory portion 4h, the sealing member 4d and the connection object 4s on the

distributing portion 4b side can contact each other fluid-tightly in a state in which the inclinations of the central axes of the accessory portion 4h and the sealing member 4d are deviated from the central axis of the connection object 4s. More specifically, even in the case where the positional accuracy in the physical relationship between the threaded portion 4b1 and the connection object 4s is set within a predetermined tolerance, the fastening axial force generated by screwing the accessory portion 4h can be applied evenly to the spherical surface 4d1 of the sealing member 4d, the substantially conical surface of the connection object 4s and a sealing portion of the accessory portion 4h in a state in which the central axis of the threaded portion 4b1 is inclined within the tolerance, or in the state in which the accessory portion 4h fitted to the threaded portion 4b1 in the thread connection remains inclined.

Therefore, the high-pressure sealing performance can be improved without increasing the processing accuracy of the threaded portion 4b1 and the connection object 4s even in the case where the positional accuracy is set within the predetermined tolerance. As a result, the production cost can be reduced, and meanwhile, the common rail 4 as the accumulation device capable of improving the high-pressure sealing performance can be produced.

In the above embodiment, the threaded portion 4b1 formed on the distributing portion 4b, which is integrated with the common rail main body 4a by welding and the like, is the

thread formed on the inner peripheral surface of the distributing portion 4b, or the female thread. Alternatively, the threaded portion 4b1 may be a male thread formed on an outer peripheral surface of the distributing portion 4b. The processing for achieving a predetermined positional accuracy in the central axis of the threaded portion 4b1 with respect to the connection object 4s is more difficult in the case where the female thread is formed than in the case where the male thread is formed by processing the outer peripheral surface. In the case where the sealing member 4d having the spherical surface 4d1 is employed, the effect of reducing the production cost is relatively great in the case where the threaded portion 4b1 is formed on the inner peripheral surface of the distributing portion 4b.

The present invention can be suitably applied to the structure in which the common rail main body 4a and the distributing portions 4b are formed as the separate parts in the preceding process, and the common rail main body 4a and the distributing portions 4b are integrated by the welding or the brazing. Thus, the fastening force generated by screwing the accessory portion 4h and the distributing portion 4b with each other can be applied stably to the connection object 4s through the sealing member 4d having the spherical surface 4d1, even in the case where the central axis of the threaded portion 4b1 of the distributing portion 4b is inclined with respect to the connection object 4s. The inclination of the central axis of the threaded portion 4b1 is caused under some

melting conditions at the welded surfaces of the common rail main body 4a and the distributing portion 4b or under some brazing conditions of the brazing with the brazing filler. Thus, the inexpensive structure can be compatible with the improvement of the high-pressure sealing performance.

The accessory portion (the flow limiter) 4h has a body 4hb, a valve member 4hv and a spring 4hs. The body 4hb is formed with a screw 4h1, which is threaded to the distributing portion 4b. The valve member 4hv is capable of reciprocating in an axial direction in the body 4hb. The spring 4hs biases the valve member 4hv toward a root of the distributing portion 4b (toward the common rail main body 4a). The accessory portion 4h is a safety device for stopping the fuel supply from the common rail 4 to the injector 2 in the case where the injector 2 injects the high-pressure fuel excessively. Thus, in a normal state, the accessory portion 4h functions as a part of the fuel passage constituting the distributing portion 4b for introducing the high-pressure fuel to the injector 2. On the other hand, only in the case where the injector 2 injects the high-pressure fuel excessively, the accessory portion 4h functions as the safety device to limit the supply of the high-pressure fuel to the injector 2.

In the present embodiment, as shown in Fig. 2, a restrictor 4hv1 is formed in the valve member 4hv for connecting an upstream side and a downstream side of the valve member 4hv. When the high-pressure fuel flows toward the injector 2 from the accumulation chamber 4c of the common rail

main body 4a through the accessory portion 4h, a pressure difference (an upstream and downstream pressure difference) is generated between the upstream side and the downstream side of the valve member 4hv by a restricting effect of the restrictor 4hv1. The upstream and downstream pressure difference increases as the flow rate of the high-pressure fuel increases. As shown in Fig. 2, the accessory portion 4h has known valve structure in which a maximum travel distance of the valve member 4hv is defined by a separation distance L between a stepped fuel passage formed on an inner surface of the body 4hb and the valve member 4hv, and the maximum travel distance L is set to a distance corresponding to a maximum limit fuel supply flow rate.

In the present embodiment, the valve member 4hv contacts the sealing member 4d, so an initial position of the valve member 4hv for determining the maximum travel distance L of the valve member 4hv is limited as shown in Fig. 2. A surface of the sealing member 4d substantially opposite from an end surface 4d2 of the sealing member 4d, at which the sealing member 4d contacts the valve member 4hv, is formed into the substantially spherical surface 4d1, which contacts the conical sealing surface 4s as the connection object. The end surface 4d2 is formed in the shape of a flat surface as shown in Fig. 2. Thus, even in the case where the central axis of the threaded portion 4b1 of the distributing portion 4b is inclined, the body 4hb and the sealing member 4d contact each other at entire peripheries thereof as shown in Figs. 2 and 3,

without partially contacting each other. It is because the sealing surface 4d1 of the sealing member 4d is formed substantially in the shape of the spherical surface, and the sealing member 4d contacts the substantially conical sealing surface 4s in a state where the substantially spherical sealing surface 4d1 is inclined along the conical sealing surface 4s. Therefore, the valve member 4hv can contact the end surface 4d2 of the sealing member 4d stably, and the initial position of the valve member 4hv for determining the maximum travel distance L of the valve member 4hv can remain stabled even in the case where the central axis of the threaded portion 4b1 is inclined.

In the present embodiment, the accessory portion 4h is explained as the flow limiter. However, the accessory portion 4h is not limited to the flow rate limiting device such as the flow limiter for limiting the supply quantity of the high-pressure fuel. Alternatively, any safety device such as a pressure limiting device including the pressure limiter 6, which limits the common rail pressure under the permissible pressure by returning the fuel, which provides the excessively high pressure, to the low-pressure fuel passage 14 in the case where the pressure of the high-pressure fuel becomes excessively high, may be employed as the accessory portion 4h. Alternatively, any other device can be employed as the accessory portion 4h if the device does not degrade the function of supplying the high-pressure fuel from the common rail 4 to the injector 2 in the normal state.

The present invention should not be limited to the disclosed embodiment, but may be implemented in many other ways without departing from the spirit of the invention.